This course is intended to enable students to make a more thorough study of various important atmospheric phenomena than is possible in the elementary course in meteorology (Geology B). The subjects discussed are as follows: Dew: theories; measurements. Frost: conditions of formation; prediction; protection. Fog: valley, lowland, and city fogs; relation to health; utilization of fog; ocean fog and its relation to navigation. Haze. Clouds: methods of formation; classification; methods and results of cloud measurements; photography; clouds as weather prognostics. Tropical cyclones: development of the law of storms; directions for handling ships in tropical cyclones; the use of oil at sea; cyclones of West Indies, eastern seas, Indian Ocean, etc.; theory of tropical cyclones.

The laboratory work consists in the examination of charts, photographs, diagrams, etc., and in the study of text-books, reports, and articles bearing upon these illustrations. Each student will also make a series of observations on dew, frost, and clouds.

Geology 2, ^2hf.—Climatology of the United States: Lectures, library work, and reports. Half course (second half year) Assistant Professor Ward.

In course 2 are considered: The controls of the climates of the United States. The annual, seasonal, and monthly distribution of temperature, pressure, winds, rainfall, cloudiness, and humidity. The probability of rainy days. The climates of special areas, as, e. g., the Plains, the Pacific coast, New England, Colorado, etc. The relations of the climates of the United States to health, habitability, occupations, and soil products. Irrigation: its present status, possible future, and dependence upon the annual rainfall or snowfall.

Geology 3, ^2hf.—Climatology of the Eastern Hemisphere: Lectures, library work, and reports. Half course (second half year). Assistant Professor Ward. (Omitted in 1903–4; to be given in 1904–1905.)

Geology 19, ^1hf.—General climatology: Lectures, library work, and a thesis. Half course (first half year). Assistant Professor Ward.

Course 19 is open to those only who have taken Course B, and to students in the Graduate School having equivalent preparation. It is recommended to those who intend to study medicine.

This course is designed to give a general knowledge of climatology in its broader aspects. The lectures present the subject according to the following heads: The astronomical relations of the earth and sun, the changes of the seasons, and the climatic zones and their subdivisions. Climatic factors. Controls of climate. Relations of climate and man, including the climatic control of habitability, occupation, migrations, government, etc. Physiological effects of different climates. Medical Climatology. Acclimatization. Geological, historical, and periodic changes of climate. The text-book is the English translation of Vol. I of Hann's Climatology.

The library and written work involves the special investigation by each student of some subject in connection with the course, and the preparation of a thesis.

Geology 26.—Climatology (advanced course): Conferences, reports, and theses. Assistant Professor Ward.

This course, which may be taken as a whole course or as a half course, provides more advanced work in the subjects of Courses B, 2, 3, and 19, and is open only to those who have passed in these courses. It is intended that the work done in Geology 26 should lead to results worthy of publication.

THE MOVEMENTS OF THE AIR WITHIN AREAS OF HIGH AND LOW PRESSURE.

The Deutsche Seewarte at Hamburg has published in its Archiv. Vol. XXII, the "Inaugural dissertation" of Dr. P. Polis, on the movements of the air within barometric maxima and minima, considered as a contribution to the theory of the cyclone and anticyclone. Doctor Polis's method of study consists essentially in following up certain trains of thought suggested by mathematical and other students and comparing the resulting suggestions with the actual records of wind and cloud movement at six well selected stations in Europe during each month of the year. The six stations are: Hoehenschwand, Carlsruhe, Breslau, Schneekoppe, or Riesenkoppe, Aix-la-Chapelle, or Aachen, Furnes, or Furness, on the coast of Belgium a few meters above sea level. He also studied the mean annual results for fourteen stations including the preceding six. Our general knowledge of the relation between the winds and the isobars had been expressed in fourteen short theorems by Van Bebber in his Lehrbuch, and these are revised by Doctor Polis, who expresses his own results as follows:

1. For different directions of the gradient (at sea level), the magnitude of the angular deviation of the wind from the gradient, or the angle alpha (α), is a function of the friction, but the velocity of the wind, as well as the orographic conditions, exert a modifying influence. [The gradient is normal to the isobar.—ED.]

2. In Europe, east winds or land winds have a small angular deviation, but west winds or sea winds have a large one. With gradients toward the southeast, the west and east winds even indicate inversions in the angle of deviation opposite to that required by the law of Buys-Ballot.

3. At altitudes of 1000 meters and above there is an outflow of air at the front, but an inflow of air at the rear of the barometric minima, considering the isobars as at sea level.

4. In the cyclone the angle of deviation is greater than in the anticyclone and generally increases with increasing depth of the cyclone.

5. The average annual deviation is generally greater in the warm season of the year than in the cold season.

6. The angle of deviation increases, both with approach to the coast and with increasing height above the ground.

7. In cyclonic motions of the air the swifter winds go with the greater angles of deviation; on the other hand, in anticyclonic motions the swifter winds accompany the smaller angles of deviation.

8. In cyclones over the land the most frequent value of the angle of deviation nearly coincides with the mean value, whereas at the coast and high stations the most frequent value considerably exceeds the mean of all.

9. The frequency of angles of deviation equal to or greater than 90° quickly increases with decreasing distance from the sea as well as with increasing elevation above the earth's surface.

10. At altitudes of 1600 meters the frequency curve for the angle of deviation shows two decided maxima; in one case when (α) is less than 90° in advance of cyclones, there is an inflowing current; in the second case for which (α) is greater than 90°, there is an outflowing current of air. Similar conditions prevail, even if not so distinctly accentuated in the rear of the anticyclone.

11. In land cyclones the greatest force of the winds occurs in the west quadrant; in cyclones on the coast and in the neighborhood of the coast, it occurs in the south quadrant; but in anticyclones in front.

12. The wind force is greater in winter than in summer, and greater in cyclones than in anticyclones.

13. The force of the wind decreases with increasing height of barometer and, inversely, it increases up to a certain point with decreasing height of barometer.

14. The great cyclones of the middle latitudes can not be explained by the distribution of pressure on the earth's surface alone.

15. The causes of the movement of cyclones are for the most part of a mechanical nature. The direction of their movement coincides with that of the air current having the greatest angle of deviation; the latter, as a rule, lies at an altitude of over 1000 meters.

16. On this account the direction of motion of cyclones is in general easterly for Europe, because most frequently the whole air column over an area of low pressure reaches up to a height of more than 1000 meters. Here and up to the region of the cirrus clouds the greatest outflow takes place in the east quadrant and the greatest inflow in the west quadrant.

17. If at an average altitude on the west side the angle (α) is greater than 90° (whence the wind in the west quadrant must blow out from the depression), then the movement of the depression takes place in a westerly direction.

18. In Europe the polar tendency of the cyclones in the warm season and their equatorial tendency in the cold season correspond to the greatest outflow of air on the Schneekoppe that corresponds to the direction of the line of motion of the cyclone.

19. The mean distance of the cyclonic centers from the sta-

tions here considered is greater in winter than in summer, and inversely the distances of the anticyclonic centers are smaller in winter than in summer.

20. In the land and the coast cyclones the greatest angle of deviation occurs at distances of 444-666 and 1110–1554 kilometers, respectively; the smallest angle occurs in the immediate neighborhood of the center, and in land cyclones at a distance of 1110–1332 kilometers; in coast cyclones from 1554-1776 kilometers.

21. At medium altitudes, on the contrary, the zone of 444-666 kilometers radius shows a principal minimum; thence, the angle increases as we go inward as well as outward and, at the distance of 666–888 kilometers, attains its principal maximum only to decrease again as it approaches the periphery of the cyclone.

22. In cyclones near the coast and at medium altitudes, the zones of the greatest and smallest angle (α) at a distance of from 444–666 kilometers, form the boundary of a cyclinder of air around which the outer air moves in spirals; on land, however, the orographic impediments disturb these very much.

23. In coast cyclones, in the exterior space, the greatest ascension of the air takes place on the south side, whereas the tangential forces hinder the ascent on the rear side. On the other hand, in land cyclones, in which the air flows inward spirally close up to the center, the location of the greatest ascension is transferred to the immediate neighborhood of the center. In consequence of the orographic inequalities, the maximum of rainfall may be shifted.

24. At medium altitudes in the inner zone the movements toward the center continue for the most part unchanged, but in the outer zones and in front there is an energetic outflow.

25. In regard to the individual seasons, in cyclones over the land, both at the ground and at medium altitudes, the various zones of (α's) show a shifting of location, whereas in coast cyclones the increase and decrease of the average value of the angle (α) occur in almost the same manner in the summer and winter seasons.

26. The variation, from summer to winter, of the greatest outflow on the Schneekoppe, indicated in theorem 18, and the resulting change in the direction of propagation of the cyclones, occurs also for each individual distance from the center. Since (although preponderating in the outer zone) in the winter season the greatest outflow occurs with westerly gradients and in the summer season with southwesterly gradients.

27. The velocity of the wind increases both with increasing distance from the periphery and from the center of the cyclone and attains two maxima, one of which is near the center and the other, according to the location of the cyclone, lies between 900 and 1300 kilometers distant from the center. In summer the location of the first maximum of the force of the wind is shoved away from its usual location near the center.

28. In anticyclones, both on the coast and over the land, the smallest angle (α) is close to the center; the largest angles are in the second zone and at the periphery.

29. On the other hand, at medium altitudes the largest (α) angles occur at distances of 666 to 888 kilometers and at 1998 to 2220 kilometers; the smallest angles are close to the center.

30. In anticyclones on the land and in those on the coast in winter the air flows from the center toward all sides of the periphery in spiral curves; furthermore, during the summer season, in the anticyclones on the coast a tangential movement of the air is observable in the north and east quadrants.

31. At medium altitudes the air on the front side flows rapidly outward, whereas in the rear it has a tendency to flow inward.

32. In anticyclones the velocity of the wind increases with increasing distance from the center and, according to the location of the area of high pressure, it attains two maxima, one of which lies at a distance of 666 to 888 kilometers; the other is in the neighborhood of the periphery.

33. The median altitude of the anticyclones is greater than that of the cyclones.

34. The coefficient of friction on the earth's surface (the k of Guldberg and Mohn) decreases as the stations are located nearer to the coast and, also, as the elevation above the earth's surface increases.

METEOROLOGY IN THE SUMMER SCHOOLS.

The development of summer schools at various universities has become a very important factor in our educational scheme. There are probably a dozen large institutions, such as Harvard, Cornell, Chicago, Columbian at Washington, and the University of Virginia at Charlottesville, that have taken up this work with great enthusiasm and very important results. These summer schools are not rivals of the various Chatauquan Assemblies, nor of the normal schools in the national educational assemblies. They fill a different field; they are peculiarly adapted to be the means of introducing new ideas to the teachers and officers of normal schools. They bring the best teachers of graded schools and academies and smaller colleges where teaching is the main thought, into close contact with the most progressive spirit of education, that which seeks out new lines of thought and new ways of looking at familiar subjects, thus leading up to original thought and research on the part of the scholar. It must be acknowledged that the rapid progress of modern civilization, or man's conquest of nature has depended on the development of the habits of independent original, but logical, not erratic, research into the laws of nature. There are those who in such work wander off into attractive but delusive byways and fail to accomplish anything. Such were the "Paradoxers" of De Morgan. It is the province of modern education culminating in the modern university, to stimulate logical and sound, original and independent trains of thought and work. From this point of view the summer school is doing a fine work, and Weather Bureau men who are so situated as to be able to contribute six weeks of hard work to this educational campaign will doubtless be rewarded by finding their best ideas reappear in the normal schools and the graded schools of the country.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

The mean barometric pressure was highest over the immediate coast of the North Pacific States, with readings of 30.10 inches. Another, and extensive, area of high but slightly lower mean pressure overlay the Ohio Valley and Tennessee and the east Gulf and South Atlantic States. The mean pressure was lowest over southwestern Arizona, with a minimum reading of 29.75 inches at Yuma.

The pressure was above the normal in the Pacific States, western Nevada, the northern Plateau region, in the Gulf States, and the Ohio Valley generally, and Tennessee, and in parts of the Mississippi Valley, with the greatest departures on the northern coast of California; elsewhere the mean pressure was below the normal, with the maximum minus departures at northern New England stations, where they were about —. 10 inch.